

REMARKS

Reconsideration is respectfully requested.

Claims 1-5, 7-14 and 16-19 are presently pending in the application. Claims 1, 4-5, and 13-14 have been currently amended.

Claims 4 and 13 have been amended to overcome the rejection under 35 USC §112, second paragraph, as not incorporating all of the limitations of independent Claims 1 and 10, on which Claims 4 and 13 respectively depend. Claims 4 and 13 have been amended to independent format to include the alternative source, TDMAT or TiCl_4 , which were described and claimed in original Claims 4 and 13. Support for the amendments can be found in the originally filed specification at page 9, lines 21-24, and in Claims 4 and 13, prior to the present amendment.

Claims 5 and 14 have been amended to once again recite the plasma treatment after the deposition of the CVD TiN layer. Support for this amendment is found in the originally filed Claims 5 and 14. A supporting amendment has also been made to the specification paragraph commencing at page 10, line 20, in order to describe the claimed method step in the specification. No new matter has been added.

Claims 1-5, 7-14 and 16-19 stand rejected under 35 U.S.C. §103(a) as being unpatentable over the admitted prior art (APA) in view of the teachings of several references, U.S. Patent No. 6,022,800 (Ho), U.S. Patent No. 6,436,819 (Zhang), U.S. Patent No. 6,187,631 (Zhao), and U.S. Patent No. 6,319,766 (Bakli). (The "et al." suffix after a reference name is omitted.)

By the above amendments to Claims 1 and 4, Applicants more specifically point out the subject matter of their invention. Specifically, the difference in depth of the first and

second contact holes, recited in Claim 10, has now been more explicitly incorporated in Claim 1, wherein the substrate is recited to be exposed in the second contact hole.

The Office Action correctly states that the Admitted Prior Art (APA) shows the formation of contact holes that extend to the dielectric layers 3 and 7, "so as to guarantee the desired differences in the thickness of the holes." Page 3, lines 12-15. However, Applicants respectfully submit that the statement that the APA "lacks anticipation primarily in that it fails to teach CVD TiN and tungsten for conductor plugs, and the plasma treatment of the TiN" is incorrect. Using the APA as a basis for modification, it is necessary to first achieve a complete understanding of the invention, as claimed, and of the motivation for providing the "glue layer being made up of both Ti and TiN layers," which is not described in any of the references. Although the desired motivation may not relate directly to the claimed structure representing the invention, it is necessary to have some motivation to combine the teaching of several references in order to obtain the claimed structure. Because the motivation for the recited elements and the proposed combination is missing, Applicants respectfully suggest that the rejection is improper.

Use of a CVD TiN conformal film 12 is relied upon as being taught by Ho, but the motivation for this is not to provide a glue layer, but rather to avoid removal of tungsten as "plug loss" in the wet etch back step, see column 3, lines 18-30 and the preamble of Claim 1. Similarly, with respect to the deposition of a TiN film, formed by a PVD process, it is not recommended by Ho because the film "usually exhibits poor 'step coverage', in that it usually does not provide conformal coverage of the high aspect surface feature." See column 3, lines 3-8.

In contradistinction, and as set forth in the originally filed specification, motivation for the present invention is to provide a structure that "can realize a stable contact resistance

by employing a glue layer..." Moreover, the TiN layer 31 is deposited over all of the inner surfaces of the contact holes 29a and 29b "including on an exposed surface of the conductive material pattern 25 in the first contact hole 29a." Page 9, lines 9-13 (emphasis added).

Recitation of this feature in is found in Claims 1 and 10. The recitation of such a CVD deposition process feature is especially important when taking into account the peculiar shape profile of the first contact hole 29a which, because of the variability in the contact profile caused by relatively lower etch rate of the conductive material 25 relative to that of the second interlayer dielectric layer 27 (see page 8, line 17-page 9, line 7) cannot provide stable contact resistance. Thus, the solution proposed is to provide a stable contact resistance by depositing the glue layer "over the first and second contact holes," as recited in Claims 1, 4, 10 and 13, in effect, "over all of the inner surfaces of the contact holes 29a and 29b on an exposed surface of the conductive material pattern 25" (see column 9, lines 13-18).

None of the relied upon references teaches a "buried" conductive material pattern, such as pattern 25, that has a lower etch rate, and thus has resulted in profile that includes a "stepped back" portion, makes it difficult to provide the desired stable contact resistance. This provides a solution to the problem for which this invention was filed as identified in the specification at page 4, lines 3-14.

Thus, the combination proposed in the rejection fails to provide a solution to the identified problem, for two reasons. Firstly, none of the references describe a similar etch problem for a conductive material that has a lower etch rate, and thus, the solution recited in the steps of the methods in Claims 1 and 10 is not something that a person having ordinary skill in the art would consider, simply because such a person would not have the etch problem, and would not be seeking a solution thereto.

Secondly, the proposed combination is not clearly taught, in that no suggestion is found in any of the references that their teachings are combinable with the teaching of the APA. At best, Ho teaches a sequential CVD deposition followed by a PVD deposition of TiN layer to provide a "barrier film" so as to fill the high aspect ratio single type contact hole, as shown in Figs. 2A-2D. Ho fails to address the problem of a "stepped back" contact hole, such as first contact hole 29a, which includes a conductive material pattern that has an etch rate that is less than that of the overlying interlayer dielectric layer, as is recited in Claims 1 and 10 herein.

The claims depending from Claims 1 and 10 include further recitations, the rejections of which rely on additional teachings taken from one or more additional cited references. For example, although it is admitted that the various alternative deposition methods recited in Claims 1 and 10, and alternatively in Claims 4 and 13, are each well known in the prior art, see specification at page 9, lines 22-24, it is not necessarily true that a person of ordinary skill in the art would be led to propose these particular methods for use in the present inventive structure, without some incentive to do so. It is respectfully suggested that such incentive is missing from the APA, and from any of the relied upon references, whether taken alone or together.

When a cited prior art reference specifically teaches against the concurrent performance steps of plasma treatment and CVD of titanium material, as does Zhao, the teachings in Bakli, col. 6, lines 7-9, that relate to a general feature of a machine having a CVD chamber without a specific and affirmative showing that the same feature of the machine is also applicable to titanium, not just tantalum material, provides an improper, or even negative motivation, to combine Bakli with that other reference. When two references specifically teach against the treatment of plasma concurrently during the deposition process

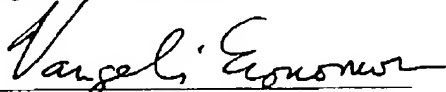
of titanium, the combination of these references is improper and cannot support the rejections, rejecting the claims as showing the limitations found in Claims 1 and 10. This impermissible combination of references is respectfully considered to be a result of impermissible hindsight, as emanating only from the understanding derived from the disclosure of the present application. See also MPEP §2143.

For these reasons, Applicants respectfully submit that Claims 1 and 10 as amended have been distinguished from the cited prior art references and are considered allowable.

For the reasons set forth above, Applicants respectfully submit that the claims 1-5, 7-14, and 16-19, as amended in this application, distinguish over the cited prior art references of record. Amendments to Claims 1, 4-5, 10 and 13 have overcome the rejections under 35 USC §112. Accordingly, reconsideration and withdrawal of the rejections and prompt allowance and passage of the application to issue are earnestly solicited. Should the Examiner have any remaining questions or concerns, the Examiner is encouraged to contact the undersigned attorney by telephone to expeditiously resolve such concerns.

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Respectfully submitted,



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